Journal of Dentomaxillofacial Radiology, Pathology and Surgery

Autumn 2019, Volume 8, Number 4

# Research Paper: clinical and radiographic methods of marginal bone loss evaluation after immediate implantation in post-extraction sockets

**Seyed Hadi Hosseini [1], Safa Motevasseli [1], Kiameher Yektan Sani [2], Donya Maleki [3*]**

[1] *Assistant professor, Department of Oral and Maxillofacial Surgery, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran*
[2] *Dentist*
[3] *Dental Student, Student Research Committee, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran*

Use your device to scan and read the article online

**Citation:** Hosseini SH, Motevasseli S, Yektan Sani K, Maleki D. linical and radiographic methods of marginal bone loss evaluation after immediate implantation in post-extraction sockets. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2019; 8(4):32-37. http://dx.doi.org/10.32598/3dj.7.4.145

http://3dj.gums.ac.ir



**Article info:**
**Received:** 2019/11/15
**Accepted:** 2019/11/25

**Keywords:**
Immediate Dental Implant Loading, Alveoloplasty, Radiography, Panoramic

## ABSTRACT

**Introduction:** To achieve the best esthetic and functional results of implantation and patient satisfaction, different protocols of implant therapy have been recommended. Immediate implantation can provide the outcome faster than other protocols making it the treatment of choice. The rate of peri-implant bone resorption should be measured clinically and radiographically as bone support is a key factor in success of implant.

**Materials and Methods:** 24 patients suitable for immediate implantation were selected. After atraumatic tooth extraction, the implant was placed and alveoloplasty was performed to reduce the implant-bone gap. A panoramic radiography was prepared 10 days after surgery and 3 months later on the day of healing cap insertion. The marginal bone loss was measured by subtractive technique. The clinical evaluation was done in same appointment by caliper. The software used for statistical analysis was SPSS 24.

**Results:** The rate of bone resorption in radiographic evaluation was 0 to 0.30 mm whereas bone resorption was clinically reported at 0 -1 mm. Finally, the Paired T test showed no statistically significant difference (P = 0.296), but there was a positive and significant correlation (P = 0.026, R = 0.453), also the success rate in the evaluation of the results of the implant surgery was 100%.

**Conclusion:** Based on the findings of this study, both methods for measuring bone analysis after implantation were acceptable and had a significant correlation. Therefore, the use of the less invasive method of radiological evaluation is recommended as a two-stage panoramic method.

*** Corresponding Author:**
**Donya Maleki.**
**Address:** School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran.
**Tel:** +989128998662
**E-mail:** donyamaleki93@gmail.com

Journal of Dentomaxillofacial Radiology, Pathology and Surgery

## Introduction

Protocols of implantation are improving to reduce the edentulous time especially in the esthetic zone and that's because nowadays a high survival and success rate can not meet patients expectations all alone as they are both accessible by the development of the features of the implant surface and application of new implant designs.(1-4)This state is confirmed with statistical results of studies which reported that the success rate of implants was 92% in replacement of hopeless teeth in terms of periodontics and 95.8% in extracted teeth in 1996 while recently a 98% to 100% success rate was demonstrated.(4,5)

Between different recommended protocols, immediate insertion of the implant is gaining interest following the aim of teeth rehabilitation as soon as possible(4,6) whereas with other protocols 3-4 months are required for osseointegration to take place.(5,7) On the other hand, it was confirmed that the patients were satisfied with the results of immediate implant placement.(5)

Although this method shortens the treatment time and cost, surely insertion of a post-extraction implant has its considerations. The presence of infection or prudence of location can limit the surgeon and the necessity of the experienced clinician can not be ignored.(4,6)

Usually, the evaluation of marginal bone loss, probing pocket depth, gingival inflammation, plaque index, soft tissue circumstance, and stability of implant is needed to show the success and survival rate of the immediate implant in fresh extraction socket.(8)

Peri-implant bone loss is an inevitable consequence in the first year commonly in the buccal plate proved by different studies (4.9.10) Previously scholars recorded that 1.5 mm resorption annually is acceptable but new investigations stated a 2 mm clinical bone loss as the maximum threshold.(2,11) Nevertheless, there are studies showed that immediate protocol could encourage the papillae reconstruction by maintaining the peripheral bone.(12) Some factors have been described as reasons of supportive bone reduction such as the thickness of the buccal bone wall, biotype of gingiva, trauma of surgery, micro-gap of implant-abutment, prosthetic parameters, parafunctional habits of patients, systemic circumstance of patients, presence of periodontium involvement, and the primary location of crestal bone toward implant.(2,4,10) This bone loss can eventually lead to peri-implant tissue inflammation affecting the maintenance of implants.(13) That is why measuring crestal bone loss clinically or radiographically is important. Using follow-up radiography is an acceptable way to record the changes in bone level around implants.(14 )

In this study, the aim was to compare clinical and radiographic methods of marginal bone loss evaluation around immediately placed implant in fresh extraction sockets.

## Materials And Method

The overall aim of this quasi-experimental intervention study is to evaluate the extent of bone resorption of immediate post-extraction dental implant treatment which have been treated with post-implantation alveoloplasty. 24 patients who had one unsustainable upper or lower anterior or premolar teeth were eligible for implant treatment. Possible systemic problems such as diabetes and bone resorption, smoking, history of chemotherapy, radiotherapy were assessed to exclude participants. Patients outside the age range of 20-50 years were also excluded to reduce the harmful effects. Intra-oral evaluations were then carried out to determine periodontium health. Also, cases with periodontitis and gingivitis were not considered. CBCT and primary panoramic radiographs were obtained from all patients. Teeth with either obvious periapical infection and lesion or periodontal, fenestration and dehiscence bone defects were put aside. Patients with localized gingivitis were treated after oral hygiene education. Then informed consent was obtained from patients. After conventional anesthesia, surgery had been performed: an atraumatic tooth extraction surgery was carried out. Note that if the surrounding tissue was destroyed, the tooth would be excluded from the study. With the help of the



Hosseini SH, et al. inical and radiographic methods of marginal bone loss evaluation after immediate implantation in post-extraction sockets. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2019; 8(4):32-37. http://dx.doi.org/

extracted tooth, the implant was selected with the proper length and diameter. Then the access flap was designed with a sulcular incision and two divergent but equal- length releasing incisions on the buccal side and was lifted with a periosteal elevator in full-thickness. Soft lingual/palatal tissue was also elevated by the elevator to not only increase visibility and access to the lingual wall of the socket, but also create a space for guiding forceps beak on the bone in the final alveoloplasty stage. After proper rinse, a standard drilling implant was performed so that at least half of the implant was inserted into the bone and was inserted 1 mm more apical than the edge of the buccal and lingual walls with appropriate torque (for initial stability) . The screws were then tightened and the final evaluation was performed at the implant site.

Then alveoloplasty with the aim of removing the implant-bone gap was done at no cost and secondary surgery. This was necessarily accomplished with the same specific forceps used for the tooth or root extraction. In such a way, the forceps with an appropriate size (the size of the forceps beaks smaller than the mesio-distal size of the tooth cavity) were placed gently on the bone under the lingual or palatal gingiva (at least 5 mm goes inside of the sulcus) and then on buccal plate. A gentle but continuous force was applied which only closes the bone edge to the implant.

To achieve wound closure, the surgical blade was replaced and a horizontal incision at the inner surface of the flap base was made to separate the adherent gingiva from the periosteum and the flap was pushed opposite the cavity. Note that the greater the buccolingual cavity size, the longer vertical releasing incisions should be made so that the released flap without traction placed on the opposite side. A not stretching flap was sutured with silk. Common post-operative considerations as well as medication (analgesic and antibiotic) were given. After 10 days, patients were referred for suture removal. At the same session, a standard panoramic radiography matched to the first stage radiography was performed. 3 months later, at the healing abutment closure appointment, panoramic radiography was performed again. The radiography (10 days after surgery and 3 months after surgery) were compared by a subtraction technique on a negatoscope to obtain vertical radiographic resorption of bone level for each implant at mm. Also, in the same session, the flap was reelevated for clinical evaluation of vertical bone resorption and it was measured using a calibrator from the titanium metal implant surface to the bone edge at mm. When the metal surface of the implant is not visible, a none-resorption value was considered and a screw with 15 N torque was placed on the implant, which if the implant rotates it indicates failure of treatment. Finally, one or two absorbable sutures were applied to the area if needed and the patient was referred for prosthetic treatment. After data collection, data were entered into SPSS software version 24 and statistical indicators such as mean, median, standard deviation, minimum, maximum and 95% confidence interval were used to determine the amount of bone resorption. PAIRED T TEST was exerted to compare changes in the height of bone. ANOVA and Independent T-tests were also used to compare bone resorption by age and gender. Significance level of tests was considered to be less than 0.05 in all cases.

## Results

In the present study, 24 patients underwent immediate implant placement by alveoloplasty and were evaluated in terms of bone resorption in a radiographic and clinical procedure. The rate of bone resorption in radiographic evaluation was at least 0 mm and at most 0.30 mm (standard deviation± mean = 0.11 ± 0.14) whereas bone resorption was clinically reported at 0.00-1.00 mm (Standard deviation ± mean = 0.10 ± 0.21) Finally, the Paired T test showed that there was no statistically significant difference (P = 0.296), but there was a positive and significant correlation (P = 0.026, R = 0.453), also the success rate in the evaluation of the results of the implant surgery was 100% and failure was not occurred. Also, there were no significant differences between the two methods of bone resorption evaluation with respect to the overlap of

95% confidence intervals at the significant level of 0.05 but 95% confidence interval in the clinical method indicated the high prevalence of this method. This study showed that according to the results of ANOVA test, there was no significant difference between the radiographic (P = 0.384) and clinical (P = 0.894) methods given by the tooth site.(Table 1) There was no significant difference in the amount of bone resorption between these two methods (Panoramic method= P = .648 and clinical method = P = .029) based on the number of the teeth on both jaws. (Table 2)

Table 1 : Clinical And Radiographic Bone Loss Evaluation Based On Tooth Location

| tooth location | Radiographic bone loss | P-value | Clinical bone loss | P-value |
|---|---|---|---|---|
| Left-maxillary | 0/10±0/11 | 0/384 | 0/12±0/29 | 0/894 |
| Right-maxillary | 0/18±0/13 | | 0/12±0/13 | |
| left-mandible | 0/15±0/06 | | 0/03±0/05 | |
| Right-mandible | 0/20±0/10 | | 0/07±0/06 | |

Table 2 : Clinical And Radiographic Bone Loss Evaluation Based On Tooth Kind

| Tooth Kind | Radiographic bone loss | P-value | Clinical bone loss | P-value |
|---|---|---|---|---|
| Central Incisor | 0/19±0/13 | 0/648 | 0/24±0/35 | 0/294 |
| Lateral Incisor | 0/17±0/12 | | 0/10±0/17 | |
| Canine | 0/10±0/08 | | 0/03±0/05 | |
| First Premolar | 0/11±0/11 | | 0/03±0/05 | |
| Second Premolar | 0/10±0/00 | | - | |

## Discussion

This study compares the clinical and radiographic methods of bone loss evaluation. Based on the results, there was no significant difference between the two methods in terms of bone resorption; however, the evaluation using these two methods also had a positive and significant correlation indicating the reliability of both methods. It should be noted, however, that the resorption rate using radiographic method was slightly higher than its amount using clinical method, which may be due to the shadow of the images and possible radiographic displacement during imaging. On the other hand, in the clinical method, some errors will be predictable due to the manual of the measurement instrument, the likelihood of individual error and also the influence of the environmental conditions such as temperature and humidity on the instruments . In this study, all 24 patients undergoing implant therapy, had a successful surgery. Given the study done by Viswambaran et al, implant success means that the specified criteria such as pain, radiolucency, and bone resorption around the implant are not met.(15,16) This study reported a complete success rate due to not using allografts, which seems to be favorable in comparison with a study done by Moein Taghavi (2010) that reported two treatment failures. Although, at first glance, the alveoloplasty process by forceps may seem invasive, this challenge will be overcome due to the high autogenous tissue regeneration capacity.(17) Many articles have recommended the use of allografts in immediate implant placement. The 100% success rate of implants in this study without the use of alloplast material is similar to the study done by Viswambaran.(15) Radiological evaluation is a common method to assess the efficacy of implant treatment. Another preferred method is histologic, but since it was not possible to perform a histologic evaluation for this human study, the clinical evaluation method was used. (18) The obtained result shows no missing implants which indicate that there is no serious damage to implants and bones of patients in this procedure, as compared to studies such as the study done by Guarnieri et al. Who reported a higher rate of failure in a similar alternative study, a flap-free immediate implant placement. (19) It also appears that closing the flap at the end by releasing the patient's own soft tissue plays an important role in increasing the success rate of this procedure without the use of allograft membranes and bones. The results of bone resorption in two-stage panoramic images, based on teeth site, showed that the lower teeth had a higher mean resorption, and the results



Hosseini SH, et al. inical and radiographic methods of marginal bone loss evaluation after immediate implantation in post-extraction sockets. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2019; 8(4):32-37. http://dx.doi.org/

of clinical bone resorption also showed that the resorption rate was higher in the upper teeth, which was not significant. In both methods to measure resorption rate; the bone resorption rate of the anterior teeth was reported to be relatively higher but not statistically significant. This finding may be due to more physical trauma to these teeth. To examine this more closely, studies with larger sample sizes should be carried out. This could also be a good title for future studies with larger sample sizes. In a study by Sanz et al. (2015), the mean level of crestal bone change induced by implant placement in submerge and transmucosal groups was 0.68 mm and 0.58 mm, respectively, and was not significantly different.20 There was no significant difference between the two groups in terms of clinical variables. Results showed excellent clinical and radiologic status over three years.(20) Our study examined only one type of immediate implant. The bone resorption rate was investigated in both radiologic and clinical methods and the results showed a very good correlation between these two methods; that this finding is partly consistent with Sanz's study. However, the positive difference in favor of this study is that any allografts was not use to cover the immediate implants. Since the use of allograft bones has been reported with different success rates, their use has always been controversial. In the study by Sadeghi et al., (2016) , the average increase in bone mass in the Cerabone group was significantly higher, but since this rate was also a percentage of resorption, so it is recommended to use the patient's own bone.(21) Besides, it should be noted that each gram of Cerabone is about 40 USD , which is equal to the value of an implant unit. Most patients may not be able to afford this cost, so a trusted approach that eliminates this problem will certainly make physicians and patients more satisfied.(21) In a study by Schiegnitz et al (2016), they reported a mean marginal bone resorption of -0.05 and -1.16 mm for the maxillary and alveolar ridge implant group. Implant success ranged from 92% to 88% over the 6 years. They concluded, "soft tissue cone implant showed a higher degree of survival and success in maxillary sinus augmentation and less peri-implant bone resorption.(22) They examined 197 cone implants while our study sample was 24 cases. In our study, none of the participants had implant failure, and the success rate was 100%. This can be due to the small number of samples and the skill of the surgeon. To determine this precisely, a larger sample size study should be designed and implemented. In this study, lower bone resorption rate, especially in the anterior regions of the maxilla, compared to the study that used another similar method, demonstrates the advantage of this method. This is a common alternative to flapless implant placement, whereas in the Guarnieri's study (2013), the success rate was reported to be less than non-incision method, which suggest the benefit of and physicians for the preparation of allograft bone membrane and powder.(19)

## Conclusion

According to the findings of the present study, both methods of bone resorption measurement after immediate implant placement were acceptable and significantly correlated. However, in the clinical method, it was more reliable due to the direct vision. All the implants used in this procedure were successful, indicating that this method is ideal. Treating patients without allograft membrane and bone are important in two ways:

1- Not using allograft and non-matched material

2- Not incurring an additional cost on patients and physicians for the preparation of allograft bone membrane and powder.

## References

1. Suarez F, Chan HL, Monje A, Galindo-Moreno P, Wang HL. Effect of the timing of restoration on implant marginal bone loss: a systematic review. J Periodontol.2013;84(2):159-69.https://doi.org/10.1902/jop.2012.120099

2. Suárez-López del Amo F, Lin GH, Monje A, Galindo-Moreno P, Wang HL. Influence of soft tissue thickness on peri-implant marginal bone loss: A systematic review and meta-analysis. J Periodontol. 2016;87(6):690-9. https://doi.org/10.1902/jop.2016.150571

3. Meijer HJ, Raghoebar GM. Immediate implant placement in molar extraction sites: a 1-year prospective case series pilot study. Int J Implant Dent. 2020;6(1):1-7. https://doi.org/10.1186/s40729-019-0201-7

4. Calvo-Guirado JL, López-López PJ, Pérez-Albacete Martínez C, Javed F, Granero-Marín JM, Maté Sánchez de Val JE, Ramírez Fernández MP. Peri-implant bone loss clinical and radiographic evaluation around rough neck and microthread implants: a 5-year study. Clin Oral Implants Res. 2018;29(6):635-43.https://doi.org/10.1111/clr.12775

5. Gupta G, Gupta DK, Gupta N, Gupta P, Rana KS. Immediate placement, immediate loading of single implant in fresh extraction socket. Contemporary Clinical Dentistry. 2019;10(2):389.

6. Wu D, Zhou L, Lin J, Chen J, Huang W, Chen Y. Immediate implant placement in anterior teeth with grafting material of autogenous tooth bone vs xenogenic bone. BMC Oral Health. 2019;19(1):266.https://doi.org/10.1186/s12903-019-0970-7

7. Vishnu VA, Sanyal PK, Tewary S, Nilesh K, Prasad RM, Pawashe K. A split-mouth clinico-radiographic comparative study for evaluation of crestal bone and peri-implant soft tissues in immediately loaded implants with and without platelet-rich plasma bioactivation. J Dent Res Dent Clin Dent Prospects. 2019;13(2):117-122. https://doi.org/10.15171/joddd.2019.018

8. Sanz-Sánchez I, Sanz-Martín I, Figuero E, Sanz M. Clinical efficacy of immediate implant loading protocols compared to conventional loading depending on the type of the restoration: a systematic review. Clin Oral Implants Res. 2015;26(8):964-82.https://doi.org/10.1111/clr.12428

9. Pohl V, Fürhauser L, Haas R, Pohl S. Gingival recession behavior with immediate implant placement in the anterior maxilla with buccal dehiscence without additional augmentation-a pilot study. Clin Oral Investig. 2020 ;4(1):1-0.https://doi.org/10.1007/s00784-019-03176-5

10. Borges T, Fernandes D, Almeida B, Pereira M, Martins D, Azevedo L, Marques T. Correlation between alveolar bone morphology and volumetric dimensional changes in immediate maxillary implant placement: a 1-year prospective cohort study. J Periodontol. 2020 ;8(1):45-60.https://doi.org/10.1002/JPER.19-0606

11. Galindo-Moreno P, León-Cano A, Ortega-Oller I, Monje A, O′ Valle F, Catena A. Marginal bone loss as success criterion in implant dentistry: beyond 2 mm. Clin Oral implants Res. 2015;26(4):e28-34.https://doi.org/10.1111/clr.12324

12. Degidi, M., Novaes, A.B., Jr, Nardi, D. & Piattelli, A. (2008) Outcome analysis of immediately placed, immediately restored implants in the esthetic area: the clinical relevance of different interimplant distances. J Periodontol. 2008;79(6): 1056-61.https://doi.org/10.1902/jop.2008.070534

13. Sesma N, Garaicoa-Pazmino C, Zanardi PR, Chun EP, Laganá DC. Assessment of Marginal Bone Loss around Platform-Matched and Platform-Switched Implants-A Prospective Study. Braz Dent J. 2016;27(6):712-6.https://doi.org/10.1590/0103-6440201601160

14. Pan YH, Lin HK, Lin JC, Hsu YS, Wu YF, Salamanca E, Chang WJ. Evaluation of the peri-implant bone level around platform-switched dental implants: A retrospective 3-year radiographic study. Int J Environ Res Public Health. 2019;16(14):2570.https://doi.org/10.3390/ijerph16142570

15. Viswambaran M, Arora V, Tripathi R, Dhiman R. Clinical evaluation of immediate implants using different types of bone augmentation materials. Med J Armed Forces India. 2014;70(2):154-62.https://doi.org/10.1016/j.mjafi.2012.04.020

16. Saini M, Singh Y, Arora P, Arora V, Jain K. Implant biomaterials: A comprehensive review. World Journal of Clinical Cases: World J Clin Cases. 2015;3(1):52-57.https://doi.org/10.12998/wjcc.v3.i1.52

17. MoeinTaghavi A, Radvar M, Aghayan S. Comparison of Stability of Implants Inserted in Ridges Augmented with Mineralized Cortical Cancellous Allograft Blocks with Implants in Native Bone Using Resonance Frequency Analysis. J Mash Dent Sch. 2010;34(1):75-80.

18. Stokholm R, Spin-Neto R, Nyengaard JR, Isidor F. Comparison of radiographic and histological assessment of peri-implant bone around oral implants. Clin Oral Implants Res. 2016;27(7):782-6.https://doi.org/10.1111/clr.12683

19. Guarnieri R, Ceccherini A, Grande M. Single-Tooth Replacement in the Anterior Maxilla by Means of Immediate Implantation and Early Loading: Clinical and Aesthetic Results at 5 Years. Clin Implant Dent Relat Res. 2015;17(2):314-26.https://doi.org/10.1111/cid.12111

20. Sanz M, Ivanoff CJ, Weingart D, Wiltfang J, Gahlert M, Cordaro L, et al. Clinical and Radiologic Outcomes after Submerged and Transmucosal Implant Placement with Two-Piece Implants in the Anterior Maxilla and Mandible: 3-Year Results of a Randomized Controlled Clinical Trial. Clin Implant Dent Relat Res. 2015;17(2):234-46.https://doi.org/10.1111/cid.12107

21. Sadeghi Ghadi S, Arab H, Radvar M. Evaluation of Horizontal Ridge Augmentation Prior to Implant Placement Via Subperiosteal Tunneling Technique Using Two Bone Graft (Cerabone and Cenobone). J Mash Dent Sch. 2016;40(3):251-8.

22. Schiegnitz E, Al-Nawas B, Tegner A, Sagheb K, Berres M, Kämmerer PW, et al. Clinical and Radiological Long-Term Outcome of a Tapered Implant System with Special Emphasis on the Influence of Augmentation Procedures. Clin Implant Dent Relat Res. 2016 ;18(4):810-20.https://doi.org/10.1111/cid.12338